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Progress in the Development of a Transportable QUISTOR/reTOF-MS for Air Monitoring

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We have constructed a transportable, direct air sampling, quadrupole ion storage/reflectron time-of-flight mass spectrometer (QUISTOR/reTOF-MS) to be used in various air monitoring applications. The design of this instrument was guided by experiments with a larger laboratory prototype. While initial results from the smaller instrument were promising, the detection limits were not as good as those of the prototype instrument. Since we obtained those results, we have been able to achieve roughly the same detection limits with the new instrument as with the laboratory prototype. We have also performed a field test in which we placed the instrument in a van and sampled the air outside the van as we drove around the Tri-Valley area, near Livermore, California.

Reducing the size of an instrument such as the QUISTOR/reTOF-MS poses several design challenges. If the vacuum pumping system is scaled down along with the instrument itself, this seriously decreases the gas load that the instrument can handle. As a result, it cannot draw in as much air, and thus sample, per unit time as the larger prototype can. If conditions in the instrument are such that the ion trap is not saturated, then this might increase detection limits. Also, one must take care in scaling down the optics of the instrument. These considerations led us to perform several diagnostic experiments. On the laboratory prototype we investigated the effects of sample flow rate on ion signal, and on the transportable instrument we examined the influence of optics settings on ion transmission.

In this work, we show results from the field test, and some of the diagnostic data. We discuss some of the issues associated with continually acquiring mass spectrometric data in the presence of an ever-changing background (as in the field test), and implications of the diagnostic data regarding the aforementioned design considerations and instrument performance.

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